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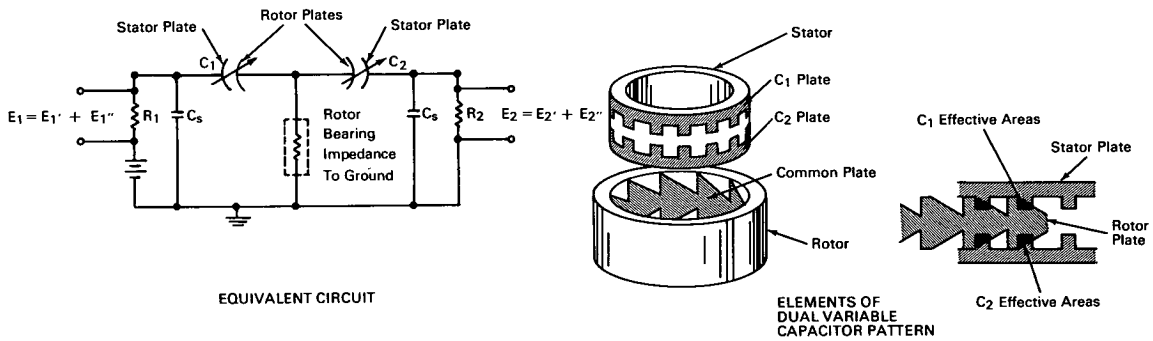
Variable-Capacitance Tachometer Eliminates Troublesome Magnetic Fields



The problem:

To design a tachometer that does not use magnetic components for the measurement of angular speed and sense of rotation. The magnetic flux from the permanent magnet in a conventional tachometer may interfere with associated instrumentation in an electromechanical system.

The solution:

A dual variable-capacitance tachometer.

How it's done:

The variable capacitors C_1 and C_2 consist of two sets of shaped, complementary plates mounted on a stator and rotor, respectively, of accurate diametrical and concentricity relationship to provide a uniform airgap between the capacitor plates. The values of the two capacitors are equal at any instant and change at equal rates in correspondence with the rotor speed. The variable capacitor plates are shaped to provide eight output pulses per rotor revolution, and a pulse polarity dependent upon sense of rotation.

During operation of the tachometer, the time-varying voltages E_1 and E_2 developed across resistors R_1, and R_2, respectively, are fed to a differential amplifier. Each of these voltages consists of two components. Voltage components E_1' and E_2', which result from charges induced on the rotor from the ac motor drive, are of equal polarity and cancel each other at the input to the differential amplifier. The charges on C_1 and C_2 from the dc voltage source will flow through resistors R_1 and R_2 in a direction to develop voltage components $E_1"$ and $E_2"$ of opposite polarity when the capacitors change value. The difference in voltage between these components is the useful tachometer signal, which is amplified and monitored.

Notes:

1. The amplifier consists of an input differential stage, a gain stage, and an emitter follower.
2. A leakage path to ground through the rotor bearing reduces possible electrostatic charge accumulations. Fixed shunt capacitances C_s provide further protection from motor drive noise.

(continued overleaf)

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3. The flux measured at an 18-inch radius from the rotor center was approximately 5 gamma, without ac motor excitation. Under the same conditions of measurement, a magnetic tachometer produced a field of approximately 250 gamma.
4. Inquiries concerning this invention may be directed to:

   Technology Utilization Officer
   Goddard Space Flight Center
   Greenbelt, Maryland, 20771
   Reference: B66-10126

Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to NASA, Code GP, Washington, D.C. 20546.

Source: Bendix Corporation
under contract to
Goddard Space Flight Center
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